University of Pittsburgh®

Health Sciences
School of Medicine

University of Pittsburgh Department of Computational and Systems Biology

Every big breakthrough in medicine was built upon a fundamental scientific discovery.

For example, the chance finding of a mold that kills bacteria laid the foundation for the first antibiotics. Better understanding of the basic structures and behaviors of proteins and molecules has led to countless drug discoveries to combat human diseases. And CRISPR-Cas9, a revolutionary gene-editing tool that enables us to change DNA and correct genetic mutations that cause disease, was made possible by research exploring a curious feature of some bacterial genomes.

Answering fundamental questions about human biology—and translating those findings so they apply to clinical care—inspires everything we do at the University of Pittsburgh Department of Computational and Systems Biology (CSB). We develop and apply computational methods and system-level analyses to address fundamental questions in biology and biomedicine. This information can lead to a new understanding of how life works and enable countless future advancements in human health.

It's relatively unusual for top medical schools like Pitt Medicine to have either a systems biology department or a computational modeling program, or the equipment and expertise required to blend the two. The University of Pittsburgh and Harvard University are among the few places in the world with this kind of a program.

Because we understand that when the two disciplines merge, we can push the boundaries of what we know.

CSB is seeking support for this mission. Read on to learn more about our unique program.

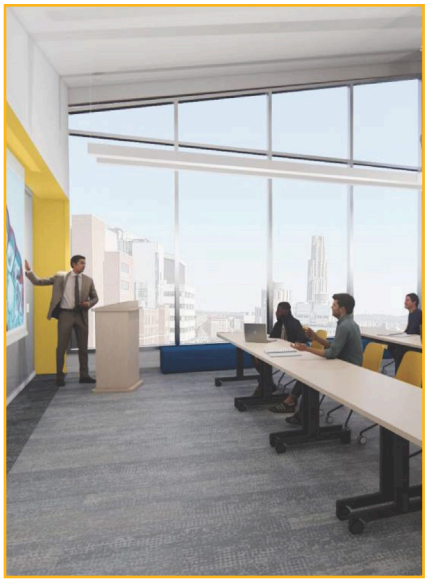
What Is Computational and Systems Biology?

CSB is a relatively new discipline at the intersection of biological science and computational science. It blends two disciplines: systems biology, which studies biological systems as a whole, and computational modeling, which uses computers to create and simulate mathematical models of complex systems, allowing researchers to analyze and predict their behavior without physical experiments.

Computational and systems biology researchers use a combination of both approaches to develop models, methods and tools to study, dissect and develop predictable models for how complex biological systems behave.

This novel field aims to answer fundamental questions in biology and biomedicine, essential for advancing research, developing new medical treatments and addressing challenges in health and the environment.

A Unique Space for Unique Work



Our program has moved into a state-of-the-art space in the center of Oakland's medical science hub. The location helps foster the collaboration among specialties that is necessary for our work and the training of the next generation of multidisciplinary scientists.

The building contains wet labs, dry labs, classrooms and advanced research technology. It houses focused, highly trained computational developers in the same space as our experts working in the lab. This encourages brainstorming and facilitates the free exchange of ideas among scientists in both disciplines. In fact, several of our experts are cross-trained in both fields.

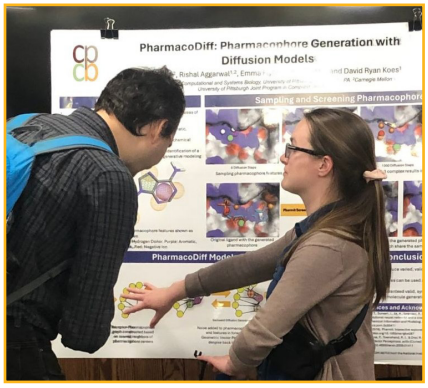
Our scientists also collaborate with physicians and researchers throughout the School of Medicine so that together we can design projects that will be meaningful to medicine.

Examples of work at Pitt's Department of Computational and Systems Biology include:

- processing and analyzing massive amounts of "multi-omic" data to gain a more complete understanding of a biological system (such as genomics, proteomics and metabolomics);
- modeling systems of proteins at the atomic level to better understand how they move and how they interact with each other;
- growing organoids in a dish thanks to our better understanding of how organ-specific cells function;
- understanding how cells find each other, grow, divide, form shapes, and develop into different types of tissues; and
- modeling gene variations and mutations to understand genetic diseases.

Training the Next Generation to Think This Way

When you understand how essential this work is to the future of human health, you realize how important it is to train people to think in this way. Therefore, Pitt Medicine is dedicated to educating computational and systems biologists.

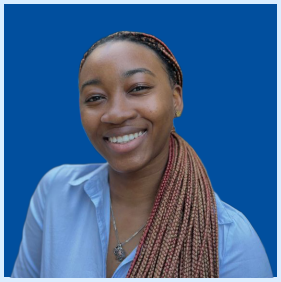


Pitt CSB is developing the next generation of scientists who are going to lead efforts to study science this way. We have partnered with Carnegie Mellon University to offer a PhD program in computational biology, and we also engage scientists at all levels of training, including undergraduate and graduate students. These trained professionals will be essential as more and more universities and companies adopt this advanced approach.

Our faculty and alumni are leaders in the field who are working on meaningful advances in medicine, such as a blood test that determines whether a patient has cancer or not and a novel way to match transplant donors and recipients.

To learn more about our alumni and their impactful projects, visit: **csb.pitt.edu/category/alumni-success**.





Fareeda Elinam Abu Juam is a PhD student at Pitt CSB who grew up in Ghana then came to the United States to study chemistry. She highlights the importance of funding so she can focus on her training and research without the added stress of large loans or part-time employment. **"I don't think I could do it without that support. I study the key dynamics of proteins and how they work through advanced analyses and simulations. This has resulted in two avenues: understanding therapeutics for COVID and even better insights into how antibodies work and mediate their therapeutic effect."** After completion of her studies, she aspires to work in industry to use her understanding of proteins in the context of disease. She says her field prepares her to **"rapidly come up with solutions to help make therapeutics and face future threats, like infection spikes, mutations and spread."**

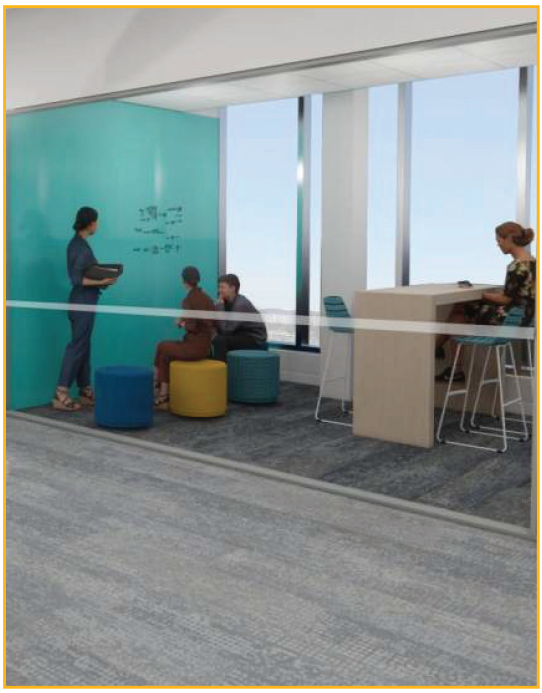


Akanksha Sachan studied chemical engineering as an undergraduate student and came to Pitt seeking guidance on a specific research path to follow. Working with faculty at CSB in both dry and wet labs, she has found her passion: **"better understanding why cells make their choices where to go next, growing and aging, differentiating, going into different states. ... The big picture is developing digital twins of people so we can predict what drug is going to work on you, test on your own cells outside of your body."** She highlights that CSB will be at the core of medical advancements. **"The future is not about cure but prevention, aging and personalized medicine."**

Support Scientific Discovery at the Intersection of Biology and Computer Science

Pitt Medicine invites your partnership with us to advance this approach to scientific discovery. Your gift will ensure that we have the necessary tools and resources to stay at the forefront of research, discovery and training the next generation.. Opportunities to support our work include:

- fellowships and stipends for our students, as well as enhanced educational and career opportunities such as scientific conferences and summer research programs with the National Science Foundation;
- endowed faculty positions to ensure we continue to recruit and retain the foremost experts and educators in our field;
- advanced computer servers, electronic microscopy with microfluidic devices, robotics for genome and proteome analysis, next-generation sequencing and cell-sorting instruments; and
- a range of program support opportunities recognizing your gift through naming of the new educational spaces at our state-of-the-art facility.



Your gift to the Department of Computational and Systems Biology—no matter the size—will make a world of difference in advancing innovation and education. You'll also be supporting the recruitment and training of the next generation of scientists; career-development initiatives for graduate students; and special educational programs that fuel inspiration and innovation among our students, faculty and staff.

To learn more about giving opportunities,

please contact Anizia Karmazyn, director of development in the School of Medicine, at +1-412-864.2237 or anizia.karmazyn@pitt.edu. Or visit: pitt.gift/csb.

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